

REMARKS/ARGUMENTS

Favorable reconsideration of this application, as presently amended and in light of the following discussion, is respectfully requested.

Claims 1 and 3-6 are pending in the application. Claims 1 and 3-6 are amended by the present amendment. Support for amended Claims 1 and 3-6 can be found in the original specification, claims and drawings.¹ No new matter is presented.

In the outstanding Official Action, Claims 1 and 3-6 were rejected under 35 U.S.C. § 103(a) as unpatentable over Pinckley et al. (U.S. Patent No. 6,983,026, hereinafter Pinckley) in view of Hongo et al. (U.S. Patent No. 7,142,615, hereinafter Hongo).

In response to the rejection based on Pinckley and Hongo, Applicants respectfully submit that amended Claim 1 and 3-6 recite novel features clearly not taught or rendered obvious by the applied references.

Amended independent Claim 1 relates to a transmitter which detects distortion components produced by a power amplifier, and uses the detected distortion components in predistorters to produce a compensation signal to cancel the distortion components at the power amplifiers.

The transmitter includes an input-side digital multi-port directional coupler (13) configured to divide and combine digital transmission signals of N-channels, and output N-combined signals to N transmission paths. N predistorters (21) are inserted in the N transmission paths, respectively, and provide compensating predistortions to the N-combined signals outputted from the input-side digital multi-port directional coupler (13). The transmitter also includes N transmitting parts (30), which are inserted in the N transmission paths, respectively, and convert output signals from the N predistorters (21) to N high-frequency signals, each of the N transmitting parts including a power amplifier (33) for

¹ e.g., specification, at least at Fig. 3.

amplifying power of the high-frequency signal. An output-side multi-port power combiner (40) divides and combines the N high-frequency signals to output N high-frequency transmission signals. Further, amended independent Claim 1 recites, in part, a transmitter, comprising:

...N receiving parts configured to extract, from said N high-frequency signals, distortion components produced by the power amplifiers and configured to generate, based on said distortion components, compensating signals which control said N predistorters, wherein
based on said compensating signals, said N predistorters generate compensating predistortions and impart said compensating predistortions to said N-combined signals from said input-side digital multi-port directional coupler, respectively, to cancel the distortion components at said power amplifiers.

Turning to the applied reference, Pinckley describes an apparatus for processing base band signals to provide low level signals for amplification that improve performance of a multi-channel transmitter.

In addressing the “N predistorters” feature recited in independent Claim 1, the outstanding Official Action relies on the components described at col. 6, lines 10-15, col. 7, lines 40-47 and col. 17, lines 56-67, and labeled with reference numerals 206 and 806 of Figs. 2 and 8. However, as described at col. 6, lines 21-48 and col. 14, lines 24-35 of Pinckley elements 206 and 806 are not predistorters but are instead compensation functions. The predistorters in Pinckley’s system are configured as baseband processing components denoted by reference numeral 205 in Fig. 2 (and also Fig. 8) and described at col. 5, line 60-col. 6, line 8.

Moreover, as described at col. 6, lines 28-34 and Fig. 2, Pinckley relates to a multi-channel transmitter, wherein a compensation matrix 206 is inter-coupled between a processing unit 205 and FTM (similar to a directional coupler) 207 to compensate for

variation in phase and amplitude among a plurality of paths based on feedback signals from the RF outputs of RF FTM 211.

Pinckley also describes that input N channel signals are divided-and-combined by a directional coupler 203 to produce N combined signals, which are recombined into N channel signals by a directional coupler (RF FTM) 215.

Specifically, in Pinckley, the directional coupler 13 divides each of N channel signals into N divided signals and combines the divided signals into N combined signals. That is, each of the N output signals from the directional coupler 13 contains components of all of the N input channel signals. The dividing-and-combining function of a directional coupler itself is well-known. In the present invention, each of the N combined signals is frequency-converted to an RF signal which in turn is power-amplified.

In contrast, Pinckley describes that two pairs of directional couplers 203, 206 and 211, 215 are used. The former pair transforms, in a digital baseband, N channel signals into N combined signals and then into N channel signals. The latter pair transforms, in an analog RF band, N channel signals into N combined signals and then into N channel signals. The RF conversion is performed on each of the N channel signals (not combined signals) in between the two pairs (i.e., between the directional couplers 206 and 211). Whereas, in the present invention, ***RF conversion is performed on the N combined signals.***

Additionally, the N paths between the directional couplers 13 and 40 were referred to as “channels” in the claims which might have caused confusion with respect to input signals of N channels applied to the input terminals 11₁ to 11_N. In order to clarify this point, the claims are amended to rename the “output N-channel signals” to “output N-combined signals” and the “N transmission channels” to “N transmission paths.”

Hongo, the secondary reference, relates to compensation for distortion produced by a power amplifier which amplifies multi-carrier signals of different frequencies. More

specifically, col. 15, lines 29-37 of Hongo describes that distortion components in the divided frequency bands produced by a common power amplifier are detected by a demodulator 12 and used to produce compensation signals, each of which is supplied to a corresponding one of predistortion units PD1 to PDn to impart a predistortion to a signal of one of the divided frequency bands. Such a configuration is used because it is difficult to achieve simultaneous compensation in multi-carrier signals over such a wide frequency band as of several tens of MHz.

In contrast, in the present invention, distortions produced by the power amplifier are compensated for by imparting a predistortion to each of N combined signals on the N transmission paths between input-side directional coupler 13 and the output-side directional coupler 40. The combined signal on each transmission path contains signal components of all of the input N channel signals as explained previously. Therefore, the present invention differs from Hongo. That is, in the Hongo patent, distortion compensation is performed in each of different frequency bands for a single power amplifier.

As explained previously, in Pinckley, the outputs of the predistorters 205 in the N transmission paths are recombined into N channel signals by the directional coupler 207 and then frequency-converted to RF signals, which are again divided-and-combined by the directional coupler 211. Even if Hongo's compensation is applied to N power amplifiers 213 in Pinckley, the combination still fails to read on all the features recited in amended independent Claim 1.

According to Claim 1, N channel signals are divided-and-combined into N combined signals each containing components of N channel signals, the N combined signals are frequency-converted to N RF signals which are amplified by N power amplifiers and the outputs of the N power amplifiers are again divided-and-combined to produce RF N channel signals. Thus, the configuration recited in Claim 1 completely differs from Hongo.

Regarding Claim 3, Pinckley describes predistorters 205 based on digital processing. As mentioned previously, however, the outputs of the predistorters 205 in the N transmission paths are again divided-and-combined into N-channel signals by the directional coupler 207 and then converted by D/A converters 233 to N-channel analog signals which in turn are frequency-converted into RF signals by up-converters 237 and the results are again divided-and-combined into N combined signals by a directional coupler 211

In contrast, Claim 1 recites that the outputs of the predistorters in N transmission paths, which are N combined signals, are D/A converted without being recombined into N channel signals, and then frequency-converted to RF signals.

Claim 4, is amended to correct errors in the use of terms “analog” and “digital” which might have caused previous misunderstanding. The D/A converters 233 explained in the cited portion of Pinckley are intended to provide analog signals to frequency-converters 237. On the other hand, the D/A converters recited in Claim 4 are intended to provide analog signals to the predistorters. In Figs. 2 and 8 of Pinckley, D/A converters 233 are provided at the output sides of the predistorters (i.e., baseband processings) 205, which means that the directional coupler 203 is based on digital processing (e.g., see col. 4, lines 52-56) and also the predistorters 205 which are provided at the output side of the directional coupler 203 are based on digital processing. Pinckley does not teach the use of analog-based predistorters for the predistorters (baseband processing) 205.

Regarding Claim 5, in Pinckley, frequency-conversion to RF signals is performed after combined signals on the N transmission paths are recombined into N channel signals by the directional coupler 207. The N RF signals are again divided-and-combined to produce N combined RF signals which are supplied to N power amplifiers.

As discussed above, the N combined signals produced by the directional coupler 13 in the present invention are added with predistortions by predistorters for compensation and then frequency-converted to RF signals which in turn are amplified by N power amplifiers.

Regarding Claim 6, in Hongo, distortion components produced by a power amplifier 4 in N frequency bands are detected. Whereas, in the present invention, a distortion component produced by each of N power amplifiers is detected.

Accordingly, for at least the reasons discussed above, Applicants respectfully request the rejection of Claims 1 and 3-6 under 35 U.S.C. § 103 be withdrawn.

Consequently, in view of the present amendment and in light of the foregoing comments, it is respectfully submitted that the invention defined by Claims 1 and 3-6 is patentably distinguishing over the applied references. The present application is therefore believed to be in condition for formal allowance and an early and favorable action is therefore requested.

Respectfully submitted,

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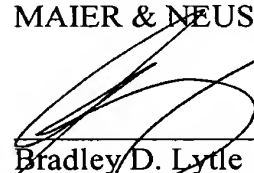
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